(Anthony et al. 1984). It is advised that toxic rodenticides not be used in raptor habitats, particularly within one mile of known raptor nests.

Generally, new roads must be built to access timber treatment areas. These roads result in increased human access, and potentially, disturbance. Some forest raptors in the study area initiate nesting when roads are still snow covered. These roads may then become passable at times coincident to incubation and brood rearing periods. Nest abandonment and lower fledging success have been observed from this type of disturbance (Call 1978, Whitfield 1993). Many birds of prey are least tolerant of disturbance during site selection, egg laying and the incubation periods (Stalmaster et al. 1982, McCarthy et al. 1987).

Timber harvesting has contributed to the alteration of over 95% of the original forest land in the United States (McCarthy et al. 1989). However, timber cutting and other treatments have not been a major impact in most of the study area. Few forest stands have been cut has on Bureau of Land Management lands within the study area. These include some trespass cutting of mature cottonwood. Several lodgepole pine and Douglas fir stands on National Forest and private lands in the upper portions of the study area have been cut in recent years. Lodgepole pine and Douglas-fir have been the targeted species for harvest on Forest Service and private lands in the area. Most of the clearing that took place in the past occurred on private lands when agricultural lands were opened up and homesteads were built. The upcoming Targhee National Forest plan will extend harvesting and fire treatment to aspen communities, which to date have not typically been harvested.

A significant impact from traditional timber management activities is the long-term conversion of late to early successional forests. Once cut, most stands are managed on a short rotation period, which never again allows the stand to reach a late successional stage. This is of concern for some of the more rare and specialized birds of prey in the study area such as northern goshawk, bald eagles (*Haliaeetus leucocephalus*), great gray, boreal (*Aegolius funereus)* and flammulated owls (*Otus flammeolus)* , which are associated with late successional forests. This is also a concern for all the small owls and kestrel, which are cavity nesting birds. These raptors are obligate cavity nesters and depend upon older trees in which cavities are located. Birds of prey such as great horned owls (*Bubo virginianus)* and red-tailed hawks have wider ecological tolerances and are more likely to benefit from timber management activities.

Conclusions and Management Recommendations. Recently published management plans on the northern spotted owl (*Strix occindentalis*) and northern goshawk have provided the most current thinking on management for forest dependent raptors. Timber harvesting, which is known to have been a significant factor in the decline of both species, is thoroughly addressed. Management recommendations are set in the context of the overall ecology of the habitats these species apparently require. Although these management plans have been developed for geographic areas other than our own, the northern goshawk management strategy is being applied throughout the Intermountain West, with some modifications.

Specifics taken from the northern goshawk management recommendations (Reynolds et al. 1992) include: maintain three suitable nest areas within a breeding area equaling 30 acres per site. In addition, three replacement nest areas are to be maintained. All six areas are to be managed as mature and older forest stands, where no adverse actions (to goshawks) can take place. Post-fledging areas of 420 acres are managed for a variety of prey and forest conditions. Timber harvesting, fire and other treatments are allowed as long as they contribute to goshawk

habitat needs and occur from October through February. Foraging areas of 5,400 acres are managed with similar objectives to post-fledging areas and for a variety of habitat conditions. The exact percentages of forest age classes varies with habitat types. The Targhee National Forest proposes to follow these guidelines under their revised Forest Plan. The strength of both documents is that they address species needs from the nest to post-fledging habitat and that they propose landscape management to mimic natural diversity.

Few other works provide a reasonable template for managing a full community of forest raptors. There are numerous good works that address individual species and their ecological needs. Each species and forest type requires an individual approach. Overall, recent thinking is moving away from a species by species management approach to a community approach, where landscapes are managed within their known ecological ranges and trends. This approach, referred to as Ecosystem Management (EM), requires a understanding of the history of the landscape. Management objectives are still dictated by desired conditions. Under this approach, managers assume that the wildlife occurs and behaves in the same habitats today as they did historically. It is also recommended by many observers that land management should give special attention to keystone, rare or specialized species. This is particularly true in monitoring the effects of land management activities. We suggest that birds of prey of the forested areas of the study area that fit the category of keystone, rare and specialized are bald eagles, goshawks and flammulated owls.

Maintenance of cavity nesting habitats requires that managers go beyond provision of a few standing snags within a clearcut. Stands should be managed for long-term recruitment of snags and older trees in which cavities develop or will be excavated within a broader context of adequate roost, foraging, and post-fledging habitats.

Recreational Activities and Human Disturbance

Some of the most ubiquitous and difficult effects to measure on wildlife are from human disturbances such as recreational activities. The effects of recreational activities on wildlife are often subtle and difficult to quantify. Individual events may appear benign, but have serious cumulative, synergistic and long-term impacts (Holmes et al. 1993, Anthony et al. 1995, Gutzwiller 1995).

Impacts associated with recreational disturbance and long-term human presence include: loss or modification of nesting and foraging habitat, introduction of non-native species which carry disease or act as predators (e.g. raccoons), increased occurrence of species that compete for nest sites (e.g. Canada geese, corvids), increased chance of electrocution, persecution (shooting), impact with structures (e.g. fences, powerlines and vehicles), toxic material poisoning, and changes in normal behaviors. Individual animals respond in various ways including: changes in their home range, increased energy use, decreased foraging efficiency, poor adaptation to new sources of predation, altered habitat use and behavior. Energetics are affected when birds fly to avoid disturbance and when they shorten foraging bouts or avoid optimal foraging habitats. Examples of this have been observed on the South Fork of the Snake River where boating, fishing and other recreational activities have been factors in determining bald eagle activity patterns and distribution during periods of extremely high human activity (Whitfield 1993). Bald eagles responded to the high fishermen activity during trout fly hatches by moving to alternate foraging sites and perching greater

distances from the river. Ultimately, productivity and survival are lowered (Anthony et al. 1995). Juvenile birds may be more vulnerable to these negative impacts since they have greater energy demands, less experience, and greater vulnerability due to their size, physiology and anatomy (Craig et al. 1988).

An individual birds experience with human persecution and factors like position in the landscape (e.g. perched versus on the ground) weigh into the variable responses seen by birds of prey to human activities (Knight et al. 1989, Knight and Cole 1991). Raptors that use areas with high levels of disturbance (e.g. along roadsides) show greater tolerance to disturbance than do birds in areas with lower levels of activity, thus illustrating some ability to habituate (Fraser et al. 1985, Buehler et al. 1991). Repetitiveness (= predictiveness) and length of time the disturbance occurs influence a bird's response and habituation.

Management Recommendations. Buffers which separate human disturbances from raptor focal points, such as nests, have been a traditional and effective management tool (Knight and Skagen 1988, Stalmaster 1987, Reynolds et al. 1992). Spatial and temporal buffer zones have been used to reduce or eliminate impacts from human disturbances. Spatial buffers are typically used around discrete areas such as nest sites and roosts. Buffer zones and timing restrictions need to be designed specific to the species and situation since there are substantial differences in response (Holmes et al. 1993). Numerous sources provide dates and dimensions for temporal and spatial buffers, respectively (Whitfield et al. 1995, Harmata 1991, Suter and Joness 1981).

Spatial buffers are already in place around bald eagle nests in the study area. They serve an important purpose and are necessary even though the current bald eagle population is growing exponentially. Recreational uses continue to increase and diversify within the study area, to the point that some areas are no longer suitable bald eagle habitat. Restrictions on human activities around sensitive sites are likely to be needed well into the future.

No other restrictions are currently in place for the protection of raptors in the study area, and do not seem necessary at this time. Discretion in the release of information on sensitive species locations is one way to minimize the potential for disturbance.

Energy and Minerals Development

Oil and gas development is the most likely type of energy resource development to take place within the study area. Fragmentation of habitats by roads, loss of habitat, potential of electrocution, noise, toxic gas pollution and increased human disturbance are among impacts posed by oil and gas developments (Postovit and Postovit 1989). Overall, there is usually an increase in human interaction with raptors and their habitat.

Seismic work can have direct impacts on birds of prey, though impacts are generally short-term. Additionally , negative effects can often be adequately avoided by directing the seismic activity away from sensitive areas or scheduling the disturbance during an non-critical period. Human disturbance is highest during exploration and habitat loss is greatest during the drilling phase when pads and roads are developed (Postovit and Postovit 1989). The significance of cumulative impacts is often lost, since detailed, intensive project analyses are usually carried out at the individual "permit to drill" phase, and not over entire fields or a watershed. Since top soils are rarely saved for reclamation, long term impacts to habitat and,

subsequently to prey, occur. Golden eagles, merlins, ferruginous hawks and northern harriers, all grassland species, have shown variable responses to oil and gas development (Suter and Joness 1981, USDI 1987, Van Horn 1993, Harmata 1991). In all cases, however, buffers are still encouraged as a method of mitigating serious impacts. Long term impacts are less understood.

Conclusions and Management Recommendations. Most management recommendations focus on the use of spatial and temporal buffers. "No surface occupancy" stipulations are another management strategy applied primarily for threatened or endangered species. Buffer distances vary by species, landscape and permitting stage (exploration versus development). Recommended buffer zones range between .5 and 1.6 mile (1 km) in distance around active nests during the general period of March 1 to August 1. These dates may vary by up to a month depending on the species, the stage of work and the location of project (latitudinal and altitudinal differences). Buffer zones are generally applied around nest sites, cliffs or other specific raptor locations like roosts and to nests or territories that are or have been recently active (<6 years). In the past many of these recommendations have been applied only during exploration and development. It is important that protective recommendations, where they apply, also be required during the production phase of work.

Agricultural Practices

Agriculture within the Rocky Mountain west is a relatively minor land use compared to other places across the United States. However, more lands within the study area have been impacted by agricultural practices than any other activity to date. Potatoes, hay and grains are the primary cultivated crops produced along the river corridor, whereas many private lands are in pasture. The negative effects of agricultural practices on raptors include modification of foraging and nesting habitat, exposure to pesticides, human disturbance, persecution, reduction of some prey species, reduced prey availability due to tall vegetation, occasional dewatering of natural waterways for irrigation, and increased predation from species that are habituated to human presence (Sharp 1986). Agricultural practices that benefit some raptors are increased nesting habitat in shelterbelts, increased prey and prey habitat (Olendorff 1973, Bloom 1980, Schmutz 1984, Bechard et al. 1986). For example, Swainson's hawks often focus foraging activity in hay fields, particularly after cuttings.

Ground nesting species, such as ferruginous hawks, and prairie falcons, which require expansive native landscapes for foraging, may be strongly impacted by conversion of native vegetation to agriculture (Snow 1974, Young 1989, Olendorff 1993). Insectivorous raptors such as flammulated owls, Swainson's hawks and kestrels are vulnerable to pesticide poisoning. Rodent and small mammal habitat can change dramatically under agricultural practices. Raptors with narrow food niches are more likely to be impacted by these changes, because they do not adjust as readily to changes in prey base.

Conclusion and Management Recommendations. Private landowners who wish to manage their agricultural land to benefit raptors might consider these recommendations:
(1) Avoid complete consolidation of agricultural fields through elimination of interspersed natural landscapes.

(2) Maintain or create windbreaks/shelterbelts using native trees and shrubs for nesting and roosting habitat.
(3) Minimize tilling land and leave fields in stubble between planting seasons to maintain small mammal habitat and reduce soil erosion (Young 1989).
(4) Avoid using pesticides that are indiscriminate and potentially toxic to non-target species such as insect eating raptors.
(5) Lands managed in the Conservation Reserve Programs (CRP) should be planted with native grasses and forbs.
(6) Vegetation along low lying irrigation systems creates oases of dense vegetation and good small mammal habitat.